Intermediate mechanics – P&A 301, Fa2020

Instructor Kaden Hazzard
TBD (problem sessions)

Office BRK 306 (KH)

Office Hours KH: Mon 12-1p, Thu 12-3, or by appointment.

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Classroom TBD
9:40AM - 11:00AM TR (lecture)
3:10PM - 4:30PM T (problem session)

Learning outcomes:

Students will be able to

- Derive equations of motion in an arbitrary coordinate system, and be familiar with the equations in Cartesian, cylindrical, and spherical coordinates
- Write down equations of motion in accelerating and rotating non-inertial frames, and know the qualitative effects of working in such frames
- Visualize dynamics in phase space. Use it to qualitatively predict the dynamics, e.g. via topology of phase space orbits
- Predict a damped harmonic oscillator's response to driving as a function of time & frequency using Green's function and Fourier methods
- Solve minimization problems using calculus of variations
- Derive classical equations of motion from Lagrangian and Hamiltonian principles
- Find the dynamics for coupled harmonic oscillators and continuous media (strings and fluids)
- Identify whether systems have potential for chaos, using criteria such as nonlinearity; define chaotic dynamics (sensitivity to initial conditions + …); explain period doubling route to chaos
- Solve and explain solutions to complex physical situations combining the elements above

Covid-19 special notes

In a typical year, we also cover planetary motion, rigid body rotation, and scattering in addition to the above, but due to the shortened semester this fall, we are likely to cover these only in abridged format, or omit them entirely. I will do my best to ensure you at least encounter the more important aspects of these topics.

Our intention is to start in hybrid format, with face-to-face lectures, but with either live (synchronous) or recorded video of the lectures available. Office hours will be done with a mix of in-person (perhaps outside) and online. This can all change quickly, as the situation in Houston and at Rice evolves. We will follow university and CDC guidelines. I will almost surely be even more cautious than they are. Your health is of foremost importance. If any issue arises with the course, talk to me as soon as possible, and we will come up with a plan. We will be as accommodating as possible.

Course credit: 4 credits

Text:

John Taylor, *Classical Mechanics*

Supplementary resources:

Marion & Thornton, *Classical Dynamics of Particles and Systems*

The Feynman Lectures, vol 1 (lower level than the course, but insightful)

Kleppner & Kolenkow, *An Introduction to Mechanics* (intermediate level between typical freshman courses and the current course)

Advanced references:

Goldstein, *Classical Mechanics*

Landau and Lifshitz, *Mechanics*

Fetter and Walecka, *Theoretical Mechanics of Particles and Continua*

Steven Strogatz, *Nonlinear Dynamics and Chaos*

Online references:

John Baez notes (a mathematician's viewpoint): http://math.ucr.edu/home/baez/classical/

Homework and evaluation:

There generally will be a homework assigned each Thursday, due the following Thursday. Problem sets will be available online. Students are encouraged to work together in approaching the problems, but should understand and write up their own solutions. **A list of other students who they discussed with should be written at the end of the assignment.** The homework should clearly explain your approach and calculation; giving the correct answer is insufficient.

Additionally, there may be "teaser questions" due at the start of class, assigned during the previous class. These guide reading and create discussion for the following class. They may be open ended. Full credit is given for thoughtful completion without regard to the correctness of the answer. No more than 5-10 minutes needs to be spent on them.

Grades, to zeroth order, are weighted with HW as 45%, teaser questions as 5%, the midterm as 25% and the final as 25%. Small reweighting can come from our interactions with you during class and office hours, and only are adjusted if they improve your grade.

Grader: TBD.

The Rice Honor Code applies to all of these assignments. Students may work together on the homework assignments, as discussed above. For the midterm and final exams, students must work alone and may consult only the materials specified on the exam cover page.

Disability and accommodations:

Any student with a disability requiring accommodations in this class is encouraged to contact the instructor after class. Additionally, students should contact the Disabled Student Services office in the Ley Student Center.